

### Remarks

In view of the above amendments and the following remarks, reconsideration of the outstanding office action is respectfully requested.

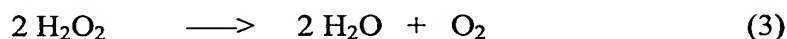
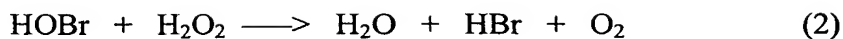
A major challenge facing the marine vessel industry is the development of an inexpensive, environmentally friendly, robust "coating" that can minimize adhesion of native marine species onto the coated surface. Current antifouling approaches work to some degree; however, they all exhibit several drawbacks, including high cost, coating material leaching, ocean pollution, and/or poor surface-to-film stability.

Oxidized sea water, produced by electrolysis or ozonolysis, has been used to prevent biofouling on flat surfaces, especially in connection with cooling water intakes of coastal power plants. As a consequence of this application, a significant body of information has been generated with respect to the chemistry associated with the antifouling agents and to their environmental impact. Oxidized seawater involves the equilibria between elemental halogens and water and the corresponding hypochlorous or hypobromous acid. Near the ocean surface, hypochlorous acid/hypochlorite will oxidize bromide to give hypobromous acid/hypobromite with the kinetics of oxidation dependent upon pH, temperature, and halide ion concentrations. Thus, the oxidation of either chloride or bromide contained in seawater will produce hypobromous acid as the primary biocide.

The hypohalous acids are produced naturally at low concentrations in seawater. Ocean water is approximately 0.5 M in chloride, 1 mM in bromide, and 1  $\mu$ M in iodide. Near the surface (0 to 25 meters), ocean water contains  $1-2 \times 10^{-7}$  M (0.1-0.2  $\mu$ M) hydrogen peroxide. The photo-oxidation of organic matter in seawater is thought to be the major source of hydrogen peroxide in the ocean via the formation of superoxide, which gives molecular oxygen and hydrogen peroxide in the presence of a proton source. Chloride, bromide, and iodide are slowly oxidized by hydrogen peroxide in the absence of a catalyst to give the corresponding hypohalous acid. Nature has taken full advantage of these resources through the evolution of the haloperoxidase enzymes, which produce the halometabolites found in many marine organisms via the enzymatic production of positive halogen species.

Once produced, the hypohalous acids/hypohalites enter a many faceted degradation scheme. As shown in equations 1-3 (below), bromide acts as a catalyst for the degradation of hydrogen peroxide through the intermediacy of hypobromous acid:





Other degradation reactions for hypohalous acids involve reduction to halide salts and water in the presence of natural reducing agents, loss to the atmosphere (as  $\text{Cl}_2$  or  $\text{Br}_2$ ), reactions with ambient ammonia to produce halamines (with oxidation of bromide by hypochlorite being more rapid than production of  $\text{ClNH}_2$  from  $\text{NH}_3$ ), and decarboxylation of amino acids found in organic matter near the surface. The production of polyhaloalkanes is a minor degradation process, accounting for less than 4% of the degradation products from hypohalous acids. Furthermore, the degradation of hypobromous acid/hypobromite as well as bromamine derivatives was found to be 2 to 5 times faster than degradation of hypochlorous acid/hypochlorite in the marine environment.

One environmental concern with the use of hypohalous acids as an antifoulant in coastal power plant cooling towers is the effect of higher concentrations of hypohalous acids on local marine organisms. Electrolysis procedures generate hypohalous acids continuously as long as the electrolysis current flows. At concentrations of hypohalous acid greater than  $40 \mu\text{M}$ , delayed hatching in several species of fish eggs has been noted. However, concentrations as low as  $0.1 \mu\text{M}$  have been effective at minimizing the adhesion of marine organisms in cooling water intakes.

Chemists have sought to mimic the halogenation reactions employed by marine organisms in the laboratory. Recent efforts in this area have involved chloroperoxidase and bromoperoxidase enzymes and model systems to mimic their activity. These systems use a transition metal (heme-bound iron for chloroperoxidase, non-heme vanadium for bromoperoxidase) to activate hydrogen peroxide for the oxidation of halide to halogen or halohydrin, which can then react with an appropriate substrate. Model studies have shown that chloride, bromide, and iodide can be oxidized by such catalysts and that the metal undergoes sequential one-electron steps. These biomimetic reactions are important to chemistry in general because they perform many desired chemical transformations such as epoxidations and halogenations in an environmentally acceptable way by avoiding unneeded byproducts and by using water as the solvent. However, the one-electron steps at the transition metal can lead to reactions derived from halogen radicals that may destroy the active catalyst.

The present invention is directed to overcoming these and other deficiencies in the art.

Claims 1-31 are currently pending.

The rejection of claims 20-22, 30, and 31 under 35 U.S.C. § 102(b) as anticipated by U.S. Patent No. 6,313,193 to Simendinger ("Simendinger") or WO 01/14497 to Jones et al. ("Jones") is respectfully traversed in view of the following remarks.

Simendinger describes an antifouling coating formulation that includes two components. The first component is a titanium silicate glass modified with a hydro- or hydroxyl-functionalized silicone polymer. The second component is a microphase separated material that includes a combination of liquid polymers, oils, or liquid waxes.

Jones describes a hydrophobic coating that can be applied as an antifouling coating to maritime and inland waterway vessels. The hydrophobic coating is formed by combining a gel with a particulate material that is capable of chemically bonding with the gel. Jones describes the gel as being formed using precursors that include water, solvents, and metal alkoxides such as tetramethoxysilane ("TMOS") and tetraethoxysilane ("TEOS").

The rejected claims (i.e., claims 20-22, 30, and 31) are directed to using a sol-gel matrix to prevent fouling of surfaces subjected to a marine environment. Claim 21 further defines the sol-gel matrix as a "sol-gel processed xerogel." With respect to Simendinger, the U.S. Patent and Trademark Office ("USPTO") has pointed to a portion of that reference (col. 2, starting at line 31) that discusses the preparation of a glass composition using a sol-gel process (*see* Office Action, mailed December 21, 2005, at page 2). Simendinger explains that this process employs "an organotitanate compound," including such compounds as titanium methoxide, titanium ethoxide, titanium isopropoxide, etc. (col. 2, lines 34-39). With respect to Jones, the USPTO has stated that this reference teaches a gel capable of forming a hydrophobic surface (Office Action, at page 2), and points to pages 2, 3, 5, and 9 to support its argument that Jones anticipates the rejected claims. However, as mentioned above, the hydrophobic coating of Jones requires a "particulate material" to be combined with the gel. Unlike the coatings of Simendinger and Jones, the rejected claims do not require combining the xerogel with additives (e.g., particulate material, oils, or liquid waxes). Further, nowhere does Simendinger or Jones teach using xerogel, by itself, as an antifouling coating. Thus, neither Simendinger nor Jones anticipates the claims of the present invention.

For the foregoing reasons, applicants respectfully submit that the rejection of claims 20-22, 30, and 31 under 35 U.S.C. § 102(b) based on Simendinger or Jones is improper and should be withdrawn.

The rejection of claims 1-3, 8-12, 17-23, and 28-31 under 35 U.S.C. § 102(b) as anticipated by U.S. Patent No. 5,677,410 to Mager et al. ("Mager") is respectfully traversed in view of the following remarks.

Mager is cited as teaching carboxysilane dendrimers that are incorporated into a sol-gel composition. Mager describes using the carboxysilane dendrimers to coat surfaces. Nowhere does Mager teach combining a sol-gel matrix with a dendrimeric organochalcogeno derivative. Applicants point out that claims 1-3, 8-12, 17-19, 23, 28, and 29 all require the sol-gel matrix/organochalcogeno derivative combination. Thus, this rejection is clearly improper with respect to these claims. Further, unlike the remaining rejected method of use claims (i.e., claims 20, 22, 30, and 31), nowhere does Mager teach using the sol-gel matrix to prevent fouling of surfaces subjected to a marine environment. Thus, applicants respectfully submit that the rejection based on Mager is improper and should be withdrawn.

The rejection of claims 1-3, 8, 10-12, 17-23, 28, 30, and 31 under 35 U.S.C. § 102(a) as anticipated by WO 02/094410 to Malik et al. ("Malik") is respectfully traversed in view of the following remarks. Malik describes a coating composition in which a dendrimer moiety is bonded to a sol-gel. However, Malik does not describe combining a sol-gel matrix with a dendrimeric organochalcogeno derivative. Nor does Malik teach using a sol-gel matrix as an antifouling agent. Thus, for these reasons and those noted previously with respect to Mager, applicants respectfully submit that this rejection based on Malik is improper and should be withdrawn.

The rejection of claims 1-3, 7, 10-12, 16, 19-23, 27, 30, and 31 under 35 U.S.C. § 102(e) as anticipated by U.S. Patent No. 6,800,330 to Hayashi et al. ("Hayashi") is respectfully traversed in view of the following remarks. Hayashi is cited as teaching a silica-based, film-forming composition in which a silane undergoes hydrolysis and condensation in the presence of a compound compatible or dispersible therein. Nowhere does Hayashi teach combining a sol-gel matrix with a dendrimeric organochalcogeno derivative. Nor does Hayashi teach using a sol-gel matrix as an antifouling agent. Thus, for the above reasons and those noted previously with respect to Mager, applicants respectfully submit that this rejection is improper and should be withdrawn.

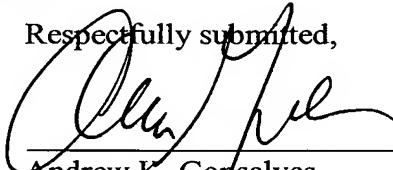
The rejection of claims 1-3, 7, 9-12, 16, 18-23, 27, and 29-31 under 35 U.S.C. § 102(e) as anticipated by U.S. Patent Application Publication No. 2004/0126595 A1 to Kwon et al. ("Kwon") is respectfully traversed in view of the following remarks. Kwon describes a nanopore-forming material for making an insulating film for a semiconductor device. In one embodiment, a nanopore-forming organic material containing a triazine derivative is admixed with an organosilicate polymer. However, nowhere does Kwon teach combining a sol-gel matrix with a dendrimeric organochalcogeno derivative. Nor does Kwon teach using a sol-gel matrix as an antifouling agent. Thus, for these reasons and those noted previously with respect to Mager, applicants respectfully submit that the rejection based on Kwon is improper and should be withdrawn.

The objection to claims 4-6, 13-15, and 24-26 as being dependent upon a rejected base claim is respectfully traversed in view of the above arguments rebutting the rejections of the based claims. Therefore, applicants respectfully submit that this objection is improper and should be withdrawn.

In view of all of the foregoing, applicants submit that this case is in condition for allowance and such allowance is earnestly solicited.

Respectfully submitted,

Date: April 21, 2006

  
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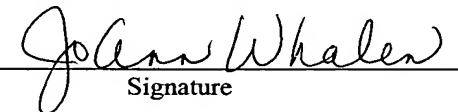
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